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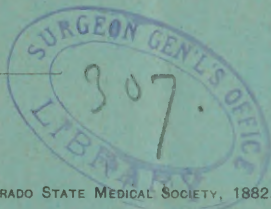
THE
INFECTIOUSNESS OF PHTHISIS,

BY

Complimentary
CHARLES DENISON, A. M., M. D.,

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DENVER UNIVERSITY.

AUTHOR OF THE ROCKY MOUNTAIN HEALTH RESORTS, &c.



[REPRINT FROM TRANSACTIONS OF COLORADO STATE MEDICAL SOCIETY, 1882.]

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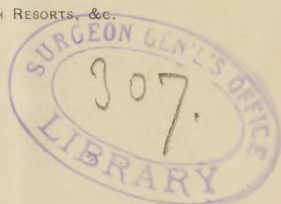
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THE INFECTIOUSNESS OF PHTHISIS.

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Just at this time a more important question could not be presented for our consideration than this inquiry into the contagiousness of consumption, i. e. the etiology of tubercle.

For years no such interest has been excited among physicians in any subject as in this new field during the past few months, through Pasteur's and Koch's experiments.

The question is of importance enough to demand more time in its preparation, and presentation to you, than I am permitted to utilize. It is well however to glance, cursorily at least, at its history and stages of development, and something like the following order suggests itself:

1. Clinical History of Contagiousness.
2. The *Bacillus Tuberculosis*.
3. Affirmative Inferential Conclusions and Possible Therapeutics.

I. CLINICAL HISTORY OF CONTAGIOUSNESS.

There has been considerable latitude of definition indulged in by authors as to the meaning of the words *Infection* and *Contagion*. These terms are generally considered as synonymous—the difference, if any, being well expressed by the adjectives *mediate* and *direct* contagion. Infection is then often applied to diseases not produced by actual contact, as typhoid and scarlet fever, while contagion in this case would refer to those produced by positive contact, as scabies, syphilis, &c.

It is sufficient, however, for our present needs to accept the definition of *infectious diseases*, given by Libermester in Zeimsen's Cyclopedia, as those originating "through the infection of the system with certain peculiar poisonous matters, and which are mainly distinguished by the fact that they can reproduce themselves, under favoring conditions, to an endless degree."

The idea that there was something contagious about consumption, was entertained by Hippocrates, Aristotle, and Galen, who in their writings advised against breathing the corrupt or offensive breath of those having such diseases.

Richard Morton and Riverius, in the sixteenth century, and Valsalva, Darwin, Dr. Benjamin Rush, in our country, and Drs. Cullen, in Scotland, and T. Reid, in England, in the seventeenth century, more decidedly pronounced their belief in contagion.

During the middle and earlier part of the present century, many close observers announced their firm belief in the contagiousness of phthisis, while many others were so much inclined to the same opinion as to insist upon precautionary measures tending to prevent the transmission of contagion, had it existed.

Prof. Andral, a prominent physician and writer of Paris, in the first part of the century, while believing that "the facility of the contagion of pulmonary phthisis has been singularly exaggerated," sums up his consideration of the subject as follows: "All that I can say, without pretending to give a final decision to such an important question, is, that in the course of my practice I have been impressed more than once by seeing women begin to show the first symptoms of a pulmonary phthisis a short time after their husbands, whose beds they had shared up to the last moment, had succumbed to this disease."

Dr. A. Crichton, in his "Practical observations on Pulmonary Consumption," (London, 1823,) says: "That a healthy person sleeping constantly with one who has an open ulcer in the lungs, and especially when the ulcerated surface is large, or where the ulcers are numerous, and when a vitiated pus is formed, almost infallibly ~~gives~~ the disorder, is a fact which has occurred to me to see so often that I have no doubt on the subject. It has fallen to my lot, particularly among the poor, to see a husband gain the disease from his wife, and many wives gain it from their husbands, under circumstances where there could be no doubt as to the influence of the poison, and no other way of accounting for the disease."

Among others, Sir Thomas Watson and Dr. Walshe, of London, withhold positive adherence to this view, the latter voicing the general conclusion of his class in these words: "But even though the reality of infection be logically unproved, it is wise to segregate the actively phthisical as far as possible; the inspiration by the healthy, of the exhalations of the diseased cannot fail to be positively, though not specifically injurious."

A good idea of the prevalence of opinion upon this question among medical men can be gained from the investigations of Dr. Henry I. Bowditch, (Annual Report Mass. State Board of Health 1872), of Dr. W. H. Webb of Philadelphia, (Amer-

Gains

ican Journal of the Medical Sciences, April, 1878), and of Dr. Edgar Holden of Newark, N. J., (next number of same journal), who canvassed the experience and views of many of the leading physicians in the United States.

Dr. H. C. Clapp, in his excellent brochure, "Is consumption Contagious?" (Boston and Providence, Otis, Clapp & Son, 1881,) has given a resume of this and other valuable information upon this subject. To this source I am much indebted for many of the facts and opinions presented in this clinical study. Without dwelling at length upon the individual views of these correspondents, it is interesting to note that over fifty-one per cent. answered *yes*, more than thirty per cent. being emphatic and giving cases, while nearly twenty-three per cent. did not answer or were in doubt, and twenty-six per cent. answered *no*. Dr. Holden's answers numbered two hundred and fifty, and Dr. Bowditch's two hundred and ten.

It is noticeable in these replies that those physicians who have much to do with lung diseases, in practice and as professors in colleges, are more generally than others believers in the contagiousness of phthisis. For instance, Dr. J. M. DaCosta writes to Dr. Webb: "I have met with a number of instances which seemed to prove the contagiouness of phthisis. I am a believer in this, although I admit the great difficulty of eliminating the law of coincidence in a disease as common as tubercular phthisis. To mention a few of the instances I have met with: 1, I attended a gentleman of tuberculous family and himself suffering from very slowly developing consumption, which in truth, was arrested for a number of years. He thrice married and lost his three wives by consumption. The third was a woman of splendid physique, and of a very healthy, long lived family. She was the mother of three children, one of whom was scrofulous. 2, The case of a young woman, twenty-six years of age, in whose family the patient assured me there never had been a case of phthisis. She died sixteen months after her husband, who had been a slowly progressive consumptive. She left two children. 3, A singular case in a splendid looking young woman, who most faithfully nursed a tuberculous husband for nearly two years, she died a year afterward of phthisis, beginning, apparently, with throat and bronchial irritation. She had, I think, no children. 4. A young woman, who accompanied her husband to Colorado, where he died a year ago of slow consumption. She is tubercular now; no case of phthisis has been known in the family except that of her mother's aunt. One of the children of the young widow died of scrofulous affection. I might give you many more examples and I notice that they chiefly happen in women."

It is, indeed, difficult to decide a question like this where the inheritance is alike for the victims of phthisis, as with sisters,

and where the burden of care and depression of mind has to be borne by the wife or husband of the slowly dying consumptive. It is this consideration which renders my own cases of somewhat uncertain value in this investigation, and I can positively attribute but six cases of phthisis to probable contagion out of five hundred patients I have kept records of since I came to Colorado, nine years ago. Two of these were young women who had nursed sisters who had died of consumption, and one of them had nursed two and immediately thereafter both broke down and showed positive signs of progressive phthisis. The one whose two sisters died with the disease, came to Colorado in advanced third stage, and died six weeks after I had sent her back to her home in Ohio, and the other came in the first stage, improved, and was lost sight of after a few months.

Two were physicians, both of whom improved in Colorado, and I think are still living there. Both were cases of fibrous phthisis in the first stage. In one, the disease made its appearance when he was seventeen, two months after the death of his grandfather, by consumption, whom he had nursed during the last six months of his life. The other, when about twenty years old, watched over a consumptive wife eight months, till her death, and immediately thereafter broke down. The fifth, an instance very much like Dr. DaCosta's second case, I have quoted, excepting that my patient, though in the third stage, (mainly fibrous,) had been a widow seven years. Her health had commenced to fail before her husband's death. She had improved afterward. She now lives in Colorado and is doing well; has had no children. The sixth is almost exactly like Dr. DaCosta's fourth case cited. She had been sleeping with her husband till I forbade it, seven weeks before his death. Soon after this advice was given, she began to show signs of commencing trouble, first in the throat, but after her husband's death, I think arrest was established. She still lives in Colorado. In the first three of the cases I have cited, there was inheritance, more or less marked, which greatly detracts from the evidence of my practice on this matter. I have, however, all along thought there might be a septic influence which was capable of being transmitted from the diseased to the healthy, especially, if the latter are rendered susceptible to contagion by their youth, sex, confinement in doors, overtaxed strength or depression of spirits.

It will be noticed that the results thus far in my cases, which I have cited, have been quite favorable. This is undoubtedly due, in a great measure, to climatic influence. I mention it as the more important if what Dr. R. E. Thompson, (*Lancet*, Nov. 6, 1880,) concludes is true i. e. that in its progress and physical signs "infective phthisis," differs from the ordinary

form, in that the pyrexia constitutional disturbance &c., are out of proportion to the physical signs; the symptoms and signs approximating closely to those of a "pyogenic or infective pneumonia." Like Dr. Thompson's cases of infection, the majority of my cases had both lungs affected; it was certainly so in four, and perhaps in five out of the six.

Did time permit I might give a large number of instances like these mentioned, which have been furnished from the records of different physicians, I will however tax your patience with only one more illustration, which is one of two lately given me by Dr. J. A. Freeman, of Millington, Illinois.

A gentleman he had always known well, who had no hereditary tendency to phthisis, married a partial invalid when he was twenty-two years of age. This lady died of inherited consumption in three or four years. Within two years thereafter he married his deceased wife's sister. This second wife during the next five years gradually became consumptive, and was a confirmed invalid for one year more, when she also died. At that time the husband had decided evidences of consolidation at the apex and center of the right lung, with some softening in progress. The left apex was slightly affected, and he performed no labor for two years. However, after the death of his second wife, he gradually improved, and now at the age of forty-eight is in good health and shows no decided evidence of existing lung disease.

Dr. A. M. McAlldowie in the *Lancet* of Nov. 12th, 1881, concludes, from an analysis of his four hundred cases of phthisis, four of which were *infective*, that the disease may be transmitted from one patient to another, and he believes that the respiratory tract is the avenue of this transmission.

Rindfleisch, in a late article in Virchow's *Archives*, presented some remarkable views upon the etiology of tuberculosis, which it may not be out of order to note here. He says tuberculosis was once a communicable disease directly from one person to another, but it is so no longer, owing to the hereditary transmission of an acquired immunity—i. e. the whole human race were once thoroughly "saturated," so to speak, with the tuberculous virus, so much so that they became proof against the effects of re-inoculation or of contagion. Reinfleisch believes that leprosy has passed through a similar evolution from a contagious disease in the time of Christ to a non-contagious disease at the present day. According to Grawitz, the mildness of small-pox at the present time may be due to a similar transmission of acquired immunity, and some have gone so far as to imagine that syphilis may yet in like manner die out as a contagious disease. But as to tuberculosis, we have yet insufficient proof that there is such contagious element

about it as would tend to an acquired immunity *to be inherited*; for at present the inheritance only makes the system, weakened thereby, the more susceptible to the infectious influence.

Dr. Buhl, of Munich, in his lectures on "Inflammation of the Lungs, &c." 1874, draws an analogy between the infectiousness of tuberculosis, in favor of which he presents much valuable evidence, and the well known contagiousness of glanders in sheep and cattle—and with the course of general syphilis in man. He avers the glanders is only a very pronounced form of milliliary tuberculosis—while the analogy to syphilis, he says, "we must not overlook, since the histological characteristics of the syphiloma are so similar to those of the lymphoma, as to be readily confounded with them."

In conclusion, I believe the clinical history of consumption evidences a certain amount of infectiousness in the disease, which it is difficult to estimate in terms usually applicable to contagious diseases. Of this we could give a moderately clear idea, as definite as possible before the real character of the contagion is established, by the expression "*contingently* contagious," i. e. communicable only when peculiarly favoring circumstances, exist such as when the breath of one in advanced phthisis is rebreathed for some time by the healthy, as a wife or nurse.

2. THE BACILLUS TUBERCULOSI.

From the necessarily incomplete, though withall very valuable evidence of clinical experience as to the idea of infection, we are gradually leading up to the more substantial proof of the existence of germinating material in tubercolosis. Our eyes are being slowly brought to see, and our minds to understand, in the realm of bacteria, new wonders which are destined, I think, to greatly influence, if not to wholly remodel our therapeutics.

Of the first to experiment by feeding tuberculous material to various animals, to see if they could be inoculated thereby, was Prof. Chauveau, of the Lions Veterinary School. He had already been thus successful with the disease glanders, but his results in tuberculosis were still greater, and excited much interest among scientific men. He chose four perfectly healthy calves, and Sept. 18, 1868, fed three of them an ounce each of tuberculous matter from an old phthisical cow. Sept. 23, No. 2 had a foeted diarrhoea, but soon recovered. No. 3 was not much affected, while No. 1, by October 1st, had failed in flesh and strength, and its respirations were increased in frequency. Oct. 5th and 7th, No. 1 and 3 were given tubercular material from the lungs of a cow not so far advanced in the disease. Result, by Oct. 9th, No. 1, great emaciaiton, cough, and rough coat. No. 2 nearly the same soon afterward. While in No. 3, the disease,

held in check till Oct. 25th, then began to progress with great rapidity. The cough was incessant and the left submaxillary gland as large as a goose's egg. No. 4, living with the others, but having no tuberculosis food, remained in perfect health. Five weeks after the commencement of the experiment the autopsies of the calves revealed very extensive tuberculosis, especially in the intestines and mesenteric glands—the latter weighing over four pounds. The intestine tubercles, especially numerous in Peyer's glands, were much ulcerated. There was ulceration also in the larynx and pharynx, and very general enlargement of bronchial, submaxillary and other glands—while tubercles in varying size were found in the stomach, pleura, and lungs. In showing that this was not due to *purulent* infection, he found that calves could swallow large quantities of common pus without injury. He considered his experiment a corroboration, and it seemed to be so, of the idea that glandular tuberculosis is more common than the other forms in early life.

Besides Chauveau, Villemin, Klebs, Gerlaeh, Gunther and Harms, Zurn and others tried many similar experiments, and their results are thus collected under four heads by Bollinger.

1. Positive results as to inoculation in one pig, out of three pigs and two rabbits, which were fed human tuberculous matter.

2. Ingestion of *tuberculous* matter from the ox.

Results, nearly always positive in five sheep, two goats and four pigs, but negative results with eight pigs and a large number of cats. The ingestion of caseous pus alone, had no effect on a sheep.

3. Ingestion of *flesh* from phthisical oxen.

Positive results in three pigs, shown by general tuberculosis and alterations in lymphatic glands. Always negative results with rabbits when fed with raw or cooked flesh.

4. Results with milk of a tuberculous cow. In three pigs miliary tuberculosis and lesions analagous to those of scorfula—negative results with fourteen rabbits fed with the milk *boiled*.

Klebs also experimented with animals giving the milk of a cow in advanced phthisis. He concluded that the use of this milk always produces tuberculosis which commences as an intestinal catarrh, then is seated in the mesenteric gland, and later in the liver, spleen, and thoracic organs. He asserts as a result of his study, "that the tubercle virus is present in the milk of phthisical cows whether they are slightly or gravely affected." "He admits that it may produce no injurious effects on vigorous subjects, and he has even observed fully developed tubercles to be absorbed and disappear after a time. He further believes that tuberculosis may be developed in children born without any tendency to it, through the medium of the milk of the mother or nurse."

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An important fact, ~~employed~~ by Dr. Paul Spillmann at Paris, in 1878, is this one drawn from the foregoing and similar experiments that it is in the abdomen first and glandular system second, that the tuberculosis transmitted by ingestion concentrates itself. Dogs and cats are much less susceptible to tubercular infection by ingestion than most other animals. Yet, Dr. Tappeiner, of Meran, in 1878, inoculated two out of eight dogs by feeding them tuberculous sputa in their food. A further test experiment by this same investigator, showed the greater susceptibility to inoculation by inhalation, than by ingestion. It was this—eleven dogs were put into a chamber in which the air was kept moist by the steam atomizer throwing into it a spray of tuberculous expectoration mixed with water. The times they were kept there varied from twenty-five to forty-five days before they were killed. "In all of them (with one doubtful exception,) were found well marked miliary tubercles in both lungs, and in some cases also in the kidneys, liver, and spleen. The microscope in each case confirmed the gross appearances. The quantity of expectoration used was very small. In these cases only fifteen grains, weighed in its ordinary moist state, was daily atomized in the chamber."

More convincing proof, and from many sources, might be here presented, with arguments pro. and con., but we must hasten on to the consideration of the artificial inoculability of tubercle.

Dr. Villemin, one of the professors at the Val-de-Grace hospital, in Paris, was one of the first to inoculate animals in this way. Young rabbits were chosen as being more susceptible to sceptic influences than other animals, and his successes were even more marked than any we have before considered. His conclusions as first summed up in 1865 and 1866, (*Gazette Hebdomadaire de médecine et de Chirurgie*,) were as follows: "Tuberculosis is the effect of a specific or virulent causal agent, —in one word of a virus. Introduced into an organism capable of being affected by it, this agent is reproduced, and at the same time reproduces the disease of which it is the essential principle and the determining cause." His inoculations were in all twenty-two, all of which were successful with two exceptions.

Dr. Wm. Marcet, of London, while Vilhimir's experiments were being repeated and confirmed by such men as M. Simon, Genaudet and others in Paris, and Lebert in Germany, first conceived the idea, and claimed to have proved it by experiment, that the character of human expectoration, whether tuberculous or not, could be settled by inoculating healthy rabbits with it and then watching them to learn if they became tuberculous. This important fact he also claimed to have settled, that "besides the pulmonary expectoration, blood and pus taken from

the human body in phthisis appear to be also possessed of the power of causing the formation of tubercle in guinea-pigs, when inoculated in these animals.

Opposed to these experiments, Drs. Andrew Clark, Wilson Fox, Burden Sanderson, of London, Max Schottelius, of Wurzburg, and others, repeated these experiments cited, also using *non-tubercular* matter—such as putrid muscle, the sputa of bronchitis, pulverized cheese, cinnabar &c. Their success was variable as to obtaining similar results to Villmien and the others, but sufficient, they believed, to weaken the argument for the unity of tubercular inoculation. Dr. Clark injected powdered cuttle-fish or sand, into the veins of rabbits, and afterwards found yellow or gray spherical masses, from the size of a mustard seed to that of a pea, in both lungs, and sometimes even secondary deposits in the liver and kidney.

It is sufficient here to state that while the irritative local or the general peculiar septic influences, set up by such experiments, are not properly eliminated from the possibility of true tubercular infection, (the limits of which are not as yet wholly within our knowledge,) yet if the truth of the results as claimed, are admitted, the fact of tubercular inoculation is not gainsayed. It is only shown that other substances, as well as tubercular matter, may give the same or similar results. How do we know but what those other substances, especially bronchial sputa, may carry with them, or excite to activity already in the body, the germs of tubercular infection? It seems to be a law in nature that the lower the forms of life the more ample are the provisions for their multiplication, as well as the possibilities for their destruction. Every cubic foot of the atmosphere is more or less full of the germs of these lower forms. May it not be then that the human organism, as well as those of lower species of animal life, have been purposely formed by the Divine hand for combating and eliminating these myriad germs of disease? If so, it ~~may~~ ^{may} be only when this eliminating process is thwarted or destroyed, that these destructive changes are rendered possible, through the multiplication and development of these unrejected septics, the bacilli and bacteria with which we have so lately become acquainted?

How is it with typhoid fever, in the germ cause of which—lately termed the *bacillus typhoidis*—we have all almost invariably believed? Cases at different foci of the disease must have *originated* from some conditions appropriate to that infection, yet how little we know of the typhoid fever contagion—whether it exists alone in filth, excreta and effluvia, or whether in these favoring conditions it has an appropriate field for development so as to become an active infection! The truth is, negative evidence, as to the infectious nature of phthisis, is of

very uncertain value, because we cannot limit the possibilities of contagion where the origination and all the properties of the infectious cause are so poorly understood as at present.

Science is progressive, however, and great advance has been made in the past year in elucidating these hidden secrets of nature. It seems to have been a good year for experimenting. The anterior chamber of the eye has been very generally chosen as the locality best suited to the observation of the successive changes produced by various kinds of inoculation of animals. Baumgarten,* three or four weeks after he had injected into the anterior chamber of the eye a few drops of blood from a tuberculous animal, had the satisfaction of seeing an eruption of tubercles appear in the lower segment of the membrane where the injected blood had lain. These local affections, as Conheim has shown, were always followed by general tuberculosis. This was also true when material from the fresh "pearls" of a tuberculous cow were used. Blood from a healthy animal was used and simply absorbed, while blood from an animal having septicemia might or might not produce a like disease, but never were these latter experiments followed by tuberculosis. This is important as answering the objections of Andrew Clark, Sanderson and others already mentioned. Toussaint, another experimenter, concludes, "that the tuberculosis of swine is analogous to the acute tuberculosis of man, while the 'pearly distemper' of cattle is always chronic in character." Deutchmann has studied the tubercular virus with a view of determining the relation of the pus cells to the serum in which they are. After carefully separating the serum from the cells in pure pus, taken from tubercular individuals, he found in the serum "a considerable number of very small and mobile elements which had the appearance of the so-called *monas tuberculosis* (the smallest kind of micrococci associated together in twos and sometimes in threes) described by Klebs and Schuller as characteristic of tuberculosis." He experimented with this serum and pus separately, but unexpectedly found that only the pus would cause the iris-tuberculosis. He also found that the aqueous humour, from the eye of a rabbit, in which this iris-tuberculosis had just appeared, when injected into the eye of a sound animal also caused no tubercular result. Later on, however, when a granular detritus or cheeseey looking particles were noticed as coming off from the developing tubercles, the injection of the aqueous humour was invariably followed by the tubercular affection. Deutchmann, therefore concludes, that the micrococci (1) may have no connection with the tubercular virus, or (2) they are the carriers and disseminators of the poison, when they develop

* W. F. Whitney, M. D., on "The Inoculability of Tuberculosis," in Boston Med. and Surg. Journal, May 18, 1882.

in the proper soil, which is the sediment of pus, or (3) they may possess specific action, which is only capable of asserting its power when the proper food for their support is introduced with the micrococci.

How closely this germinating process is of late being studied and elucidated is shown by the remarkable information conveyed in a paper on the etiology of tuberculosis recently presented by Dr. Robert Koch to the Berlin Physiological Society. Koch's conclusions are based upon two extremely interesting discoveries, the credit of which is due wholly, so far as we know, to his own indomitable energy and skill. These two facts are (1) the discovery of the *Bacillus tuberculosis*, a parasite which is universal in all tuberculous tissue, and (2) the cultivation of these bacilli independent of the tissues in which they have found an abiding place. This minute bacillus is described as rod-shaped, being from one-fourth to one-half the length of a red blood-corpuscle. Resembling somewhat closely the bacillus lepræ, it is thicker, slightly split at the end, and colors somewhat differently with the dyes used in preparing it for microscopic observation. He claims that he has found no true tubercle in which it was absent. The proofs he furnishes are summarized as follows: "In eleven cases of miliary tuberculosis, the bacillus was always found; in twelve cases of caseous pneumonia, in one of tuberculosis of the brain, in two of interstitial tuberculosis, in three of freshly extirpated scrofulous glands, and in four of fungous joints, the organism was also present. Among lower animals, the bacillus was discovered in ten cases of pearl disease; in the caseous cervical gland of a pig, in the organs of a hen dead from tuberculosis, and in three monkeys, nine guinea pigs, and seven rabbits. The bacillus was inoculated in 172 guinea pigs, 32 rabbits and 5 cats. In all cases the animals died of tuberculosis, and the organism was not found in non-tuberculous or non-scrofulous tissues." *

As to the cultivation of the bacilli, it was done by depositing tuberculous cells upon thickened serum of ox blood, previously heated to destroy all existing organisms. These cells slowly, requiring many days, gave off two or three spores which developed to rod-bacilli, which would only grow at a temperature between 30° and 41° cent. These cultivations were continued for a long time so as to test the earlier and later crops separately. Over sixty different animals were tried, injections being made into various parts of the body, and in almost all cases they caused a true tuberculosis. Bacilli were found in the sputa of phthisical persons, but not in that of ordinary bronchitis. The gradual development of phthisis is explained by

* N. Y. Medical Record, May 20, '82.

the slow and peculiar development of these bacilli. By the term tuberculosis, of which the bacillus is the cause, Koch means scrofulous and catarrhal phthisis, as well as tuberculous disease proper. Of course Koch believes tuberculosis is contagious. He holds that the sputa and exhalations of phthisical persons, as well as the milk and flesh of tuberculous cows, are a source of danger.

Such are the remarkable results claimed through Koch's experiments. Should they turn out to be substantiated, and Prof. Tyndal's prophesy, in his letter to the *London Times*, be fulfilled—i. e. that the bacilli may be modified by cultivation till they become prophylactic—then may we hand down the name of Robert Koch to future generations as one of the greatest benefactors of the human race.

3. AFFIRMATIVE INFERENTIAL CONCLUSIONS AND POSSIBLE THERAPEUTICS.

The length of my paper has already been so much greater than I anticipated, that I think it best to only outline here what I had intended to elaborate under this head.

1st. Koch's discoveries would seem to bring tuberculosis into the classification of zymotic diseases, which, based upon the discovery of bacilli or bacteria, would already embrace typhus and typhoid fevers, scarletina, diphtheria, mumps, small-pox, phthisis, syphilis, leprosy, purpurial fever, intermittent and remittent fevers, septicæmia, anthrax, and probably croupous pneumonia, rheumatism, yellow fever, and cholera. Much of the credit for this advance in our knowledge of these diseases, is due to the French scientist Pasteur, whose proof that "all fermentation is due to organic germs, and that each sort of fermentation is caused by a specific sort of germ" seems to substantiate the previously held belief that *all zymotic diseases originate from fermentation*.

2d. That scrofula has this relation to tuberculosis. It is a true diathesis particularly suited to favor the development of the infectious principle which is characteristic of tuberculosis. In the words of M. Rendu as "the soil to the seed—scrofula being the soil in which tuberculosis develops readily."

3d. There is probably a common etiology for all forms of phthisis, whether cheesy pneumonia, tuberculosis, or fibrous phthisis in so far (whatever their anatomical differences are) as they originate from a common source, which source has its existence and thrives according to unique and peculiar laws, however poorly they may be understood.

4th. That the theory of the bacterial nature of phthisis is in harmony with, and explanatory of, our past inability to greatly

lessen the total mortality in the world from this devastating plague—consumption. It coincides with, and in a measure, accounts for, the steadily increasing existence of the disease in localities where it was formerly unknown. Did time permit I could present many illustrations of this, even to its origination, as we may yet see it in the cities of Colorado, in the reputed health resorts of the country.

5th. The theory of the bacterial origination of phthisis is in perfect accord with the methods of treatment—more particularly the climatic cure—which we here in Colorado have found best calculated to arrest the disease.

Prof. Tyndall has well explained that the existence of atmospheric germs is less and less pronounced as we rise from the level of the sea. Our own observations as to the lessening of insect life in the Rocky Mountains—the natural result of the cold nights and the great diurnal variation in the temperature—tend to show that the air is purer and freer from the germs causing disease or irritation of the lungs, at those altitudes which are considered beneficial for consumptives.

Furthermore, may it not be, that the beneficial influence of counter irritation, and of fistulous and artificial derivative means of staying the progress of phthisis, is in perfect accord with this newly found theory of the disease, and is it not for that reason they are valuable as eliminators of the germs which saturate the phthisical body?

The increased eliminating capacity due to quickened and increased respiratory activity, coincident with the more perfect capillary circulation, (favoring as these do an improved oxygenation of the blood and a reestablishment of nervous strength,) are also to be mentioned as concurrent means of combatting and warding off the inroads of tubercular virus in these high altitudes.

6th. And lastly:—The hope is strong, and is even now being partially realized, that these discoveries forerun the presentation to the medical profession of such germacidal remedies, for general and thorough antiseptis, as may be taken to the full purification of the phthisical system without marked injury to human economy. Time does not permit, and my own experience is not yet sufficient, to suitably present the claims of remedies, such as carbolic acid, eucalyptus, &c., as germacides; but it occurs to me in closing, that the following question is worthy of careful consideration: Is it not probable that most of those remedies have been germacides, upon which as "*alteratives*," so called, we have always relied, i. e., such as mercury, iodine and its compounds, arsenic, quinine, nux vomica, mineral acids, sulphur, etc?

